Organization(s): **Microcosm Technologies; Caliper Technologies Corp; and University of Washington**

Title: FlumeCAD: Integrated CAD for Microflume Components and Systems

Duration of Effort: July 1998 - December 2001

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Objective

The goal of the FlumeCAD project is to create a CAD system to allow start-to-finish design of a broad class of Microchemical Fluidic Systems. This requires the capability for full simulation of the Microflume systems at a time domain system level and tools for optimizing and programming designs.

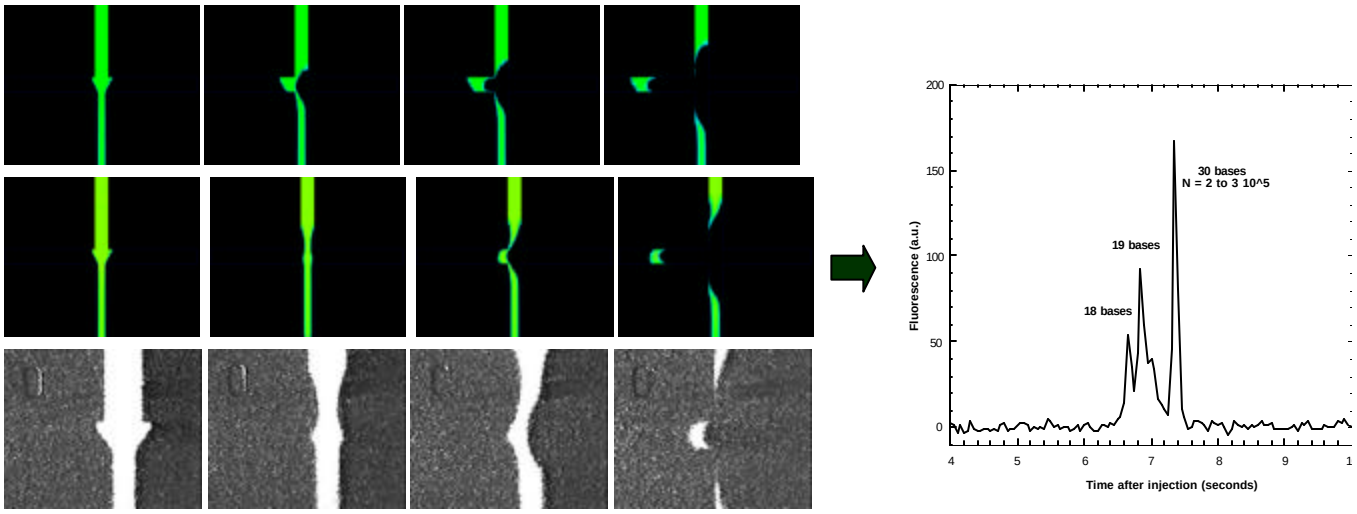
Progress/Results

- Extended generator based model construction to automatic mesh generation for planar/anisotropic and isotropically etched cross sections. Geometrical parameters can be automatically varied to determine the behavior of the device to variations.
- Existing FlumeCAD modules have been extended to incorporate several new physics. These include non-newtonian flows, dielectrophoresis, non-linear electrophoresis etc. New releases in Q1 and Q2 2000 and scheduled for Q4 2000.
- System modeling libraries for microfluidic components created and scheduled for release in next version. Library components include components for transport, actuation and separation.
- FlumeCAD applied in the design of a better injector using a reverse injection mechanism. The numerically designed injection was experimentally verified at Caliper and yielded the fastest separations yet.
- Papers published in premier conferences: uTAS 2000 (1 oral, 3 posters), Hilton Head 2000 (1 oral). FlumeCAD application results referenced in 13 papers at uTAS.

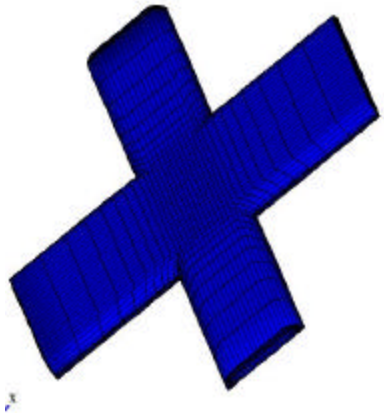
Status

- FlowMM - System modeling capability release is as scheduled. The module consists of a library of analytical and extracted components (first version) and the capability to extract models for components (later version).
- New version of Mesh generators in development. This includes more complex shapes including combinations of primitives as well as the capability to allow users to generate combinations. Additionally more physics-specific meshing is incorporated.
- New releases scheduled for Q4 2000 and Q2 2001. Significant improvements to usability planned in these releases. Additional physics based on user input is also planned.

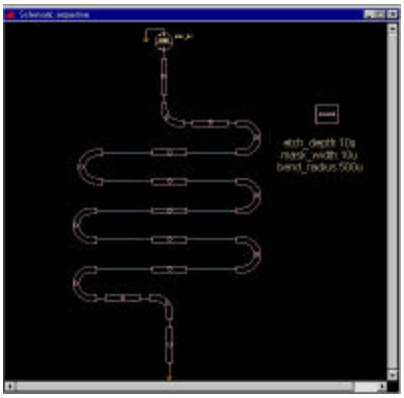
Microcosm



Design of injector with FlumeCAD. Top figure is the conventional injector with two phases (load and switch). Middle figure is the improved design with three phases (load, reverse and switch), resulting in a narrower and straighter band in the separation column. Bottom figure is the experimental verification. The resulting separation is shown in the graph on the right.



Automatically generated mesh for an isotropically etched cross injector. All geometrical parameters are automatically variable.



FlowMM schematic for serpentine channel. Models for each component are extracted by detailed simulation over a range of parameters.

FlowMM schematic for capillary separation. Two samples of varying diffusivity and mobilities are shown separating in the column.